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EVALUATION OF PROCESSING TOMATO BREEDING LINES AND CULTIVARS FOR MECHANICAL HARVESTING AND QUALITY IN 1979

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In Ohio, tomatoes continue to be the most important processed crop with a planted acreage of over 19,000 acres and almost one-half million ton production, ranking second only to California. New cultural practices, machine harvest-bulk handling, and altered processing practices continue to create need for better suited varieties. This breeding work continues to be especially directed toward improvement of the whole-pack product, and other needs of the smaller canner in relation to this product. Emphasis is also placed on the development of improved types for use in the production of juice, sauce and paste.

To insure progress toward increased productivity and for more effective utilization of present yield limits, attributes being selected for include, seed germination cold tolerance, earliness and good fruit setting ability, especially during period of heat stress to avoid split set; of equal importance is crack resistance, ability of ripe fruit to store well on the vine for extended periods and firmness to allow for effective machine harvest and bulk handling. To reduce production costs, jointless pedicel (j2) is being incorporated to facilitate machine harvest and allow delivery of fruit free of stems. Improved quality factors being selected for include: acidity, pH, solids, color (Crimson-og^c and High Pigment-hp) and especially fruit attributes conditioning efficient peeling characteristics and corelessness.

In 1979 there was an increase in commercial acreage planted of the new machine harvest jointless pedicel cultivar Ohio 7663, as a choice for early season whole-pack production. Field results continued good and in-plant processing evaluation demonstrated that this cultivar had excellent peeling characteristics and small core. It is anticipated that the acreage of Ohio 7663 will increase in Ohio and the Midwest in 1980 and commercial size seed lots are available from ADI Distributors, Inc., Carmel, Indiana.

NEW PROMISING OHIO ADVANCED BREEDING LINES

The advanced lines, O7630, O7681, O7814, O7864, O7868, O7869, and O7870 continued their good performance in 1979.

A Verticillium-Fusarium resistant line, O7630, exhibited good fruit size for hand or machine harvest, and good holding characteristics, productivity, and high quality, making it especially suitable for use in product. O7681 also in commercial trials had excellent productivity and large fruit size and has exhibited wide

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adaptability. It is a Verticillium-Fusarium resistant, firm, high quality line adapted to hand or machine harvest, primarily for product use.

07814, an early Fusarium resistant, jointless pedicel, machine harvest type, exhibited good potential in commercial trials. It is firm and suitable for coreless whole-pack use.

07864 and 07870 are jointless pedicel, main season, machine harvest lines which performed well in commercial trial. These Verticillium-Fusarium resistant, firm types are adapted for use in coreless whole-pack.

07868 and 07869 are main season Verticillium-Fusarium resistant Crimson og^C types which have exhibited potential in commercial trials for hand harvest, as well as machine harvest. They are firm and suitable for product or whole-pack.

Several new breeding lines are available which exhibit potential for improvement in productivity and quality over present varieties (Tables 1,4). These lines will be extensively tested and are being used in crossing to develop newer types with more desirable combinations of productivity and quality utilizing the highest levels of these characteristics available in a range of different breeding backgrounds and maturities. Progress continues in the development of varieties more adapted to machine harvest, but the need for a greater choice of suitable types remains. New lines and varieties from other sources were also included in these studies.

CULTURAL INFORMATION

Plants: Greenhouse-grown, 108 per standard flat from seed sown April 1.

Transplanted to Field: May 21, a two-row transplanter using 21-53-0 starter at 5 lb. per 100 gal. of water; 1/2 pint per plant.

Fertilizer: 1000 lb. per acre of 0-26-26 broadcast October 21. 70 units of nitrogen in Urea form applied May 8.

Soil: Silty clay loam, fall bedded October 20.

Herbicide: Vegiben 10% granules, 40 lb. per acre 2 weeks after transplanting.

Plot Size and Spacing: One-row plots, 20 plants per row spaced 12 inches, rows 5 feet apart. Three replications.

Irrigation: None applied.

Insect and Disease Control: Air blast sprayer application according to recommendation of Dithane M22, Dithane M45, Tribasic copper, Bravo, Sevin and Guthion as follows:

June 18	Sevin & Copper
June 25	Dithane M-45 & Sevin
July 12	Copper & Guthion
July 18	Bravo
July 27	Copper, Sevin & Dithane M-22
August 16	Sevin & Bravo
August 28	Bravo & Dithane M-45

Weather Data (Vickery, Ohio)

	Temperature		Rainfall (inches)	
	1979	25 Year Avg.	1979	25 Year Avg.
May	58.7	58.5	4.27	3.33
June	67.9	68.1	4.12	3.83
July	70.2	72.2	2.40	4.12
August	69.2	70.3	3.81	3.60
September	63.6	64.2	1.37	2.91

May was characterized by above average rainfall and below average temperature. June had above average rainfall. These conditions in combination with below average July and August temperatures tended to delay maturity, but dry conditions the latter part of the season tended to accelerate ripening and ripe fruit concentration; this facilitated machine harvest and allowed for high percentage ripe fruit recovery and high yield levels.

Harvesting was with an FMC Tomato Harvester and was carried out when the entries were estimated to be at a stage of fruit ripeness in which yields of marketable fruit were approaching optimum recovery (Tables 1 & 3). Percentages reported of fruit recovery are on a weight basis.

Fruit quality was determined by evaluation of hand harvested samples from each plot (Tables 2 & 4).

QUALITY EVALUATION

Ten field run tomatoes were selected and used for quality evaluation; the sample was cut in half, quartered, extracted in a Food Processing Equipment Co. Laboratory pulper, and de-aerated.

1. Hunter Color and Color Difference Meter; standardized with L = 25.59, aL = 27.40 and bL = 12.54 plates.

2. Agtron E-5. Instrument calibrated at 48.

3. Hunter D-6 Tomato Colorimeter (TCM).

4. Percent soluble solids. Abbe refractometer.

5. Percent total acid as citric. The raw sample used for pH determination was directly titrated using 0.1 normal sodium hydroxide solution to a pH of 8.1.

6. pH was determined by the glass electrode method.

7. Vitamin C (ascorbic acid) standard procedure:

$$\text{Dye factor} \times \text{ml. of dye} \times 100 = \frac{\text{mgs. Vitamin C}}{100 \text{ gms}}$$

TABLE 1.--Trial I. Field Evaluation of Processing Tomato Varieties and Test Lines for Mechanical Harvest When Yields of Marketable Fruit Were Approaching Optimum Recovery, Vegetable Crops Branch, OARDC, Fremont, Ohio 1979.

Variety or Test Line	Seed Source	Ripe Usable Tons/A	Ripe Usable % of Potential	% of Potential cull	Fruit size (oz.)	Stems %	Stems Joint	Disease Resistance
Harvest Date 9/5/79								
O 7814	1	35.7	85	3	2.4	0	j2	F
Heinz 2653	6	24.8	82	9	2.6	1	j2	V-F
Peto 80	11	24.6	80	9	3.1	30	+	V-F
Harvest Date 9/11/79								
VF 134-1-2	11	30.5	84	8	3.6	39	+	V-F
USDA 77B68	16	30.1	81	9	3.2	76	+	V-F
Ohio 7663	1	28.9	72	6	3.2	4	j2	F
Hunts 304	5	27.9	83	8	3.2	54	+	V-F
UCX 211-58-6	14	27.4	77	13	3.4	61	j2	F
Ont 744-3	8	26.7	73	15	4.0	4	j2	F
O 7826	1	24.9	71	5	2.7	81	+	F
Ont 777	8	23.0	72	16	5.0	93	+	F
Veepro	8	22.3	68	13	3.9	5	j2	F
Harvest Date 9/14/79								
Heinz 2567	6	35.3	76	4	3.9	1	+	V-F
Heinz 2867	6	34.3	88	3	3.1	1	+	V-F
US 28	16	33.1	81	7	4.4	4	j2	V-F
Peto 81	11	32.4	86	9	3.8	68	+	V-F
Campbell 38	3	30.2	76	5	3.2	1	j2	F
Chico III	11	30.7	74	4	3.1	59	+	F
Heinz 414	6	30.9	81	8	3.8	3	j2	V-F
O 7823	1	22.5	79	6	2.6	99	+	F
Harvest Date 9/17/79								
O 7681	1	40.2	80	9	4.7	95	+	V-F
O 7828	1	39.4	79	8	4.7	100	+	V-F
O 7836	1	37.8	84	8	3.4	87	+	F
O 7837	1	37.4	85	6	3.0	76	+	F
O 7832	1	35.6	76	5	3.5	3	j2	V-F
O 7931	1	32.2	82	12	3.8	1	j2	V-F
Harvest Date 9/20/79								
Campbell 37	3	35.0	81	8	3.9	1	j2	F
US 141	16	29.8	76	9	3.7	0	j2	V-F
Red Rock	16	27.4	75	9	4.4	3	j2	V-F
LSD 5%		8.3	NSD	3	0.4	13		

TABLE 2.--Trial I. Laboratory Evaluation of Processing Tomato Varieties and Test Lines, Vegetable Crops Branch, OARDC, Fremont, Ohio 1979.

Variety or Test Line	pH	% Citric Acid	% Soluble Solids	Color			Vit. C
				Hunter CDM a/b	Agtron E5	Hunter D6 TCM	
O 7814	4.4	0.29	4.2	2.65	32.0	69.0	15.1
Heinz 2653	4.6	0.29	4.6	2.61	32.0	78.9	19.5
Peto 80	4.5	0.22	3.8	2.45	34.7	75.3	17.0
VF 134-1-2	4.5	0.29	4.0	2.52	33.5	73.1	16.4
USDA 77B68	4.4	0.26	4.2	2.62	32.1	75.9	20.2
Ohio 7663	4.5	0.30	4.5	2.61	33.0	76.6	15.8
Hunts 304	4.4	0.31	4.5	2.73	31.2	80.3	18.9
UCX 211-58-6	4.2	0.36	4.7	2.71	30.8	70.9	15.8
Ont 744-3	4.5	0.24	4.5	2.76	32.0	80.4	23.9
O 7826	4.4	0.27	4.3	2.55	33.2	76.4	17.6
Ont 777	4.4	0.24	4.7	2.79	31.4	81.5	23.3
Veepro	4.6	0.22	4.3	2.69	32.0	80.5	18.3
Heinz 2567	4.5	0.25	3.7	2.57	31.5	77.6	13.2
Heinz 2867	4.4	0.33	5.0	2.74	32.9	80.3	18.3
U.S. 28	4.5	0.25	4.2	2.56	30.9	78.5	19.5
Peto 81	4.6	0.24	4.0	2.75	31.2	79.5	17.0
Campbell 38	4.4	0.30	4.8	2.69	31.0	77.2	18.3
Chico III	4.5	0.26	4.5	2.63	32.1	79.3	15.8
Heinz 414	4.4	0.29	5.2	2.57	33.0	77.1	22.1
O 7823	4.4	0.26	4.3	2.60	30.4	79.6	19.5
O 7681	4.5	0.23	4.5	2.63	33.7	78.8	13.9
O 7828	4.5	0.28	4.5	2.60	33.4	78.1	16.4
O 7836	4.5	0.29	4.6	2.71	31.8	78.9	20.8
O 7837	4.5	0.28	4.5	2.59	32.0	77.8	23.9
O 7832	4.5	0.24	4.6	2.72	33.0	78.5	16.4
Ohio 7630	4.4	0.27	4.0	2.61	34.8	75.9	18.3
O 7931	4.4	0.28	4.6	2.68	32.0	78.3	19.5
Campbell 37	4.4	0.31	4.7	2.60	33.0	77.4	19.5
US 141	4.5	0.27	4.6	2.59	33.5	75.4	19.5
Red Rock	4.3	0.28	4.4	2.56	34.2	76.6	20.2

TABLE 3.--Trial II. Field Evaluation of Processing Tomato Varieties and Test Lines for Mechanical Harvest When Yields of Marketable Fruit Were Approaching Optimum Recovery, Vegetable Crops Branch, OARDC, Fremont, Ohio 1979.

Variety or Test Line	Seed Source	Ripe Usable Tons/A	Ripe Usable % of Potential	% of Potential Cull	Fruit size (oz.)	Stems %	Stem Joint	Disease Resistance
Harvest Date 9/5/79								
O 7974	1	36.2	81	8	3.8	1	+	V-F
O 7987	1	29.5	84	4	2.9	5	+	V-F
O 7878	1	28.8	84	7	3.9	5	j2	F
O 7984	1	27.3	81	3	2.6	0	j2	F
Harvest Date 9/11/79								
O 7859	1	40.3	83	5	3.1	0	j2	F
O 7864	1	34.3	84	4	3.4	23	+	V-F
O 7814	1	31.1	83	5	2.9	0	j2	F
VF 134-1-2	11	28.4	82	7	3.5	35	+	V-F
O 7843	1	20.2	85	7	3.1	22	+	V-F
Harvest Date 9/14/79								
O 7989	1	40.4	85	5	3.0	29	+	V-F
O 7870	1	37.4	86	4	3.6	64	+	V-F
O 7883	1	37.1	79	5	3.1	0	j2	F
O 7868	1	37.0	86	6	3.8	55	+	V-F
O 7858	1	32.9	81	8	3.4	1	j2	F
O 7983	1	32.2	85	6	2.7	0	j2	F
O 7986	1	31.5	85	9	3.4	31	+	V-F
O 7891	1	31.0	86	9	3.1	0	j2	F
Harvest Date 9/17/79								
O 7874	1	40.7	86	7	3.5	0	j2	V-F
O 7681	1	36.4	78	6	4.9	95	+	V-F
O 7869	1	34.2	82	4	3.9	89	+	V-F
O 7630	1	32.6	77	4	4.3	77	+	V-F
O 7980	1	32.5	84	8	3.1	0	j2	F
O 7982	1	30.2	85	6	2.7	1	+	F
O 7855	1	28.1	77	5	3.1	33	+	V-F
Harvest Date 9/20/79								
O 7893	1	34.6	82	10	3.7	0	j2	F
Campbell 37	3	34.2	82	8	3.8	3	j2	F
LDS 5%		9.8	NSD	3	1.0	16		

TABLE 4.--Trial II. Laboratory Evaluation of Processing Tomato Varieties and Test Lines. Vegetable Crops Branch, OARDC, Fremont, Ohio 1979.

Variety or Test Line	pH	% Citric Acid	% Soluble Solids	Color			Vit. C
				Hunter CDM a/b	Agtron E5	Hunter D6 TCM	
O 7974	4.4	0.31	4.5	2.82	32.1	78.8	18.3
O 7987	4.5	0.27	4.4	2.66	30.8	77.7	15.1
O 7878	4.3	0.32	4.7	2.79	31.3	76.9	18.9
O 7984	4.5	0.31	4.2	2.75	29.9	80.9	18.9
O 7859	4.3	0.28	4.5	2.65	32.8	77.2	18.3
O 7864	4.5	0.31	4.6	2.70	32.0	73.9	13.2
O 7814	4.3	0.35	5.0	2.83	29.5	79.5	18.3
VF 134-1-2	4.4	0.32	4.5	2.54	31.8	74.5	19.5
O 7843	4.5	0.31	5.0	2.78	30.6	78.6	18.3
O 7989	4.4	0.20	4.5	2.73	31.5	78.8	20.2
O 7870	4.5	0.28	4.2	2.66	33.2	76.9	18.9
O 7883	4.5	0.31	4.3	2.57	32.5	75.8	16.4
O 7868	4.5	0.25	4.8	2.78	32.0	76.1	16.4
O 7858	4.3	0.31	4.3	2.80	33.0	77.6	15.1
O 7983	4.4	0.36	4.6	2.69	32.0	76.0	18.3
O 7986	4.5	0.26	4.2	2.71	30.0	78.8	15.1
O 7891	4.3	0.33	4.7	2.86	32.0	81.1	20.8
O 7874	4.6	0.24	4.2	2.54	34.4	76.2	17.0
O 7681	4.4	0.23	4.8	2.65	30.9	77.5	18.3
O 7869	4.4	0.27	4.0	2.72	30.9	78.9	15.8
O 7630	4.4	0.29	5.1	2.51	33.2	75.0	19.5
O 7980	4.4	0.29	4.4	2.72	31.2	78.9	20.2
O 7982	4.5	0.29	4.5	2.71	33.2	74.8	18.9
O 7855	4.5	0.30	5.0	2.68	30.5	77.1	15.1
O 7893	4.4	0.33	4.7	2.89	29.7	83.4	18.3
Campbell 37	4.5	0.31	5.0	2.61	32.0	76.1	17.6

TABLE 5.— Evaluation of 1979 N.T.E.P. (Northern Tomato Exchange Program), OARDC, Wooster, Ohio
(Rating Score: 5 Excellent - 1 Poor)

NTEP Entry No.	Cultivar	Source	Earliness	Cover	Set Concentration	Fruit Size	Cracking	Firmness	Separation	Stylar Scar	Internal Color	Coreless Whole-Pack	MH	HH
7901	St-43	10	4	2	4	4	2	2	2	2	3	3	HH	--
7902	79NC102	7	3	4	2	2	2	4	3	4	2	3	MH	HH
7903	Md 150	2	1	5	3	4	5	3	2	4	1	1	MH	HH
7904	Heinz 414	6	3	2	2	4	4	2	1	1	1	2	MH	--
7905	Ohio 7869	1	3	4	3	4	4	3	1	2	4	4	MH	HH
7906	Ont 7615E	8	2	4	2	3	5	3	3	2	2	1	--	HH
7907	PU 79A03	16	3	3	5	2	4	3	4	3	4	5	MH	--
7908	NY 475	12	4	3	5	2	2	1	5	5	4	2	MH	--
7909	Ont 787	8	3	4	2	3	3	5	3	2	5	3	MH	--
7910	Ohio 7630	1	2	3	3	4	3	2	3	3	3	2	MH	HH
7911	79NC101	7	2	4	3	3	4	3	4	3	3	4	MH	--
7912	Heinz 2653	6	5	1	5	3	2	3	2	4	4	3	MH	--
7913	PU 78-298	16	4	2	4	3	3	1	4	4	4	4	MH	--
7914	Libby 8990A	13	3	2	3	2	2	1	4	3	2	2	MH	--
7915	Ohio 7681	1	3	3	4	5	3	3	3	3	2	3	MH	HH
7916	Md 151	2	3	4	1	2	4	2	5	5	2	4	MH	--
7917	St - 32	10	3	3	3	2	4	1	1	3	3	3	--	HH
7918	Campbell 37	3	2	5	2	3	3	3	2	3	5	2	MH	HH
7919	NY 78-265	12	2	3	4	2	5	1	5	5	1	3	MH	--
7920	Ohio 7731	1	2	4	3	2	4	2	5	5	3	2	MH	--
7921	Ont 778	8	2	3	2	4	4	3	4	1	5	4	--	HH
7922	USDA78B182	15	2	5	2	4	4	4	3	3	3	3	MH	--
7923	Ont 7710	8	5	2	3	3	2	1	1	4	3	1	MH	--
7924	Md 149	2	4	2	3	3	4	2	3	4	4	4	MH	--
7925	St-47	10	2	4	2	3	2	1	2	3	5	5	MH	HH
7926	PU 79A05	16	2	5	3	3	4	1	3	4	3	1	MH	--
7927	USDA77B68	15	3	4	3	2	4	3	4	3	1	3	MH	--
7928	Md 153	2	2	4	2	2	4	3	3	3	3	4	MH	--
7929	St-41	10	1	4	4	3	4	4	1	3	2	3	MH	--
7930	Ont 771	8	4	2	5	4	2	2	2	1	4	3	--	HH
7931	Ohio 7814	1	2	3	2	2	5	4	4	5	3	1	MH	--
7932	PU 79A04	16	3	3	3	3	4	3	3	4	2	1	MH	--
7933	NY 77-459	12	1	4	2	2	4	2	3	2	5	3	MH	--
7934	Md 152	2	2	2	3	2	3	3	2	3	4	2	MH	--
7935	79NC103	7	1	4	3	2	5	3	3	5	1	3	--	HH
7936	Libby 68	13	2	4	4	3	4	2	5	5	3	2	MH	HH

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